From Performance-Based Earned Value (PBEV) to the Capability Maturity Model-Integrated (CMMI^{SM})

**NDIA CMMI Technology Conference and User Group
Denver, Colorado**

Developed by: Paul Solomon

Northrop Grumman Integrated Systems

Solompa@mail.northgrum.com

Presented by: Chris Cool

Northrop Grumman Integrated Systems

Agenda

- **Earned Value Management (EVM), the Integrator**

- **Performance-Based Earned Value (PBEV)**

- **Mapping of the CMMI**
  - **To Technical Performance Measurement (TPM)**
  - **To the EVM Industry Standard**

- **SCAMPI Cost Reduction Opportunity**

- **Process Improvement During Transition to the CMMI**
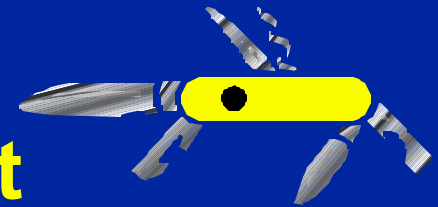
- **CMMI Change Requests Submitted**

- **Conclusion**

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Integrated Systems Lean Enterprise System
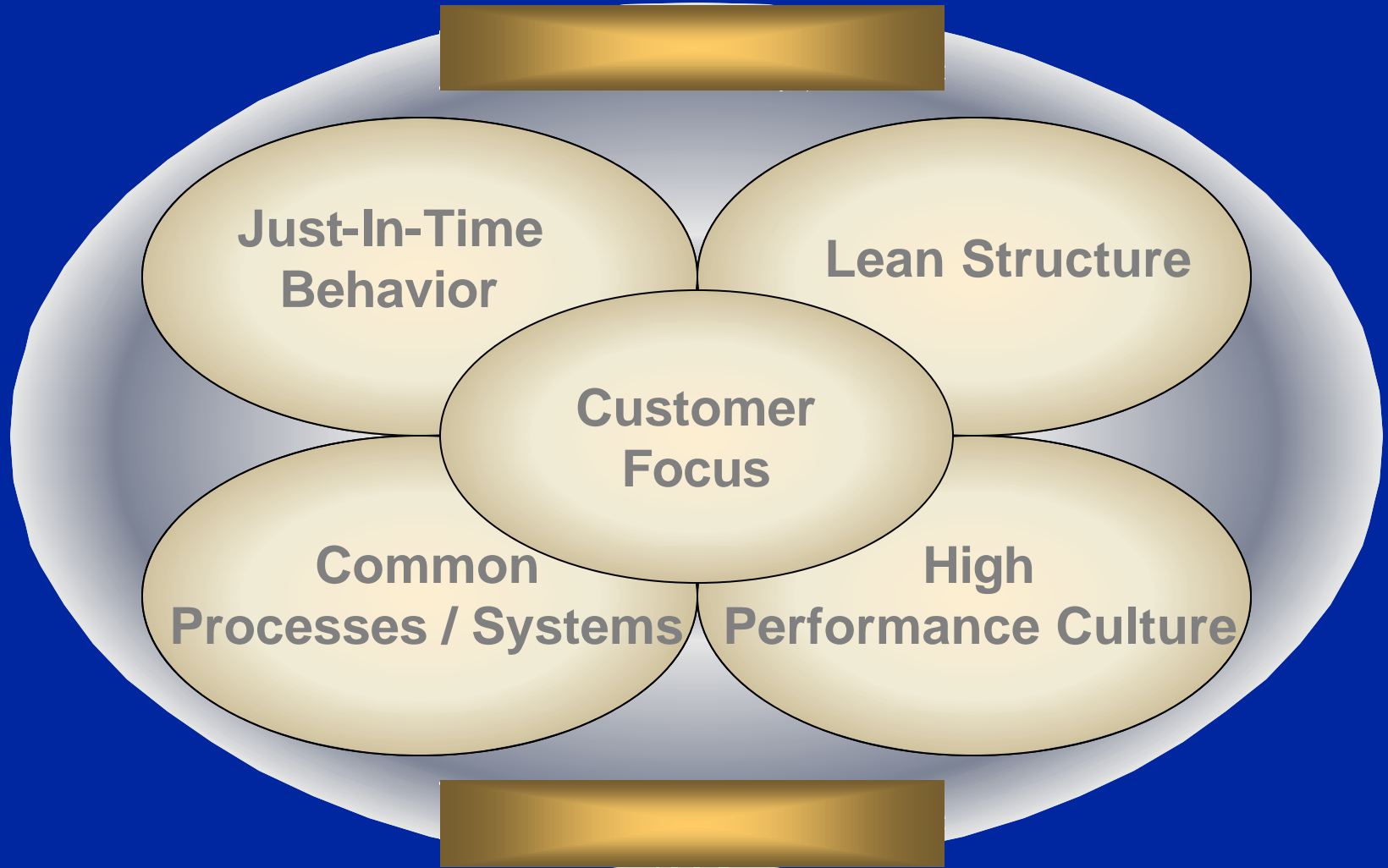
Integrated : the "I" in CMMI and IPPD

EVM **Is the Primary Project Management Tool...**

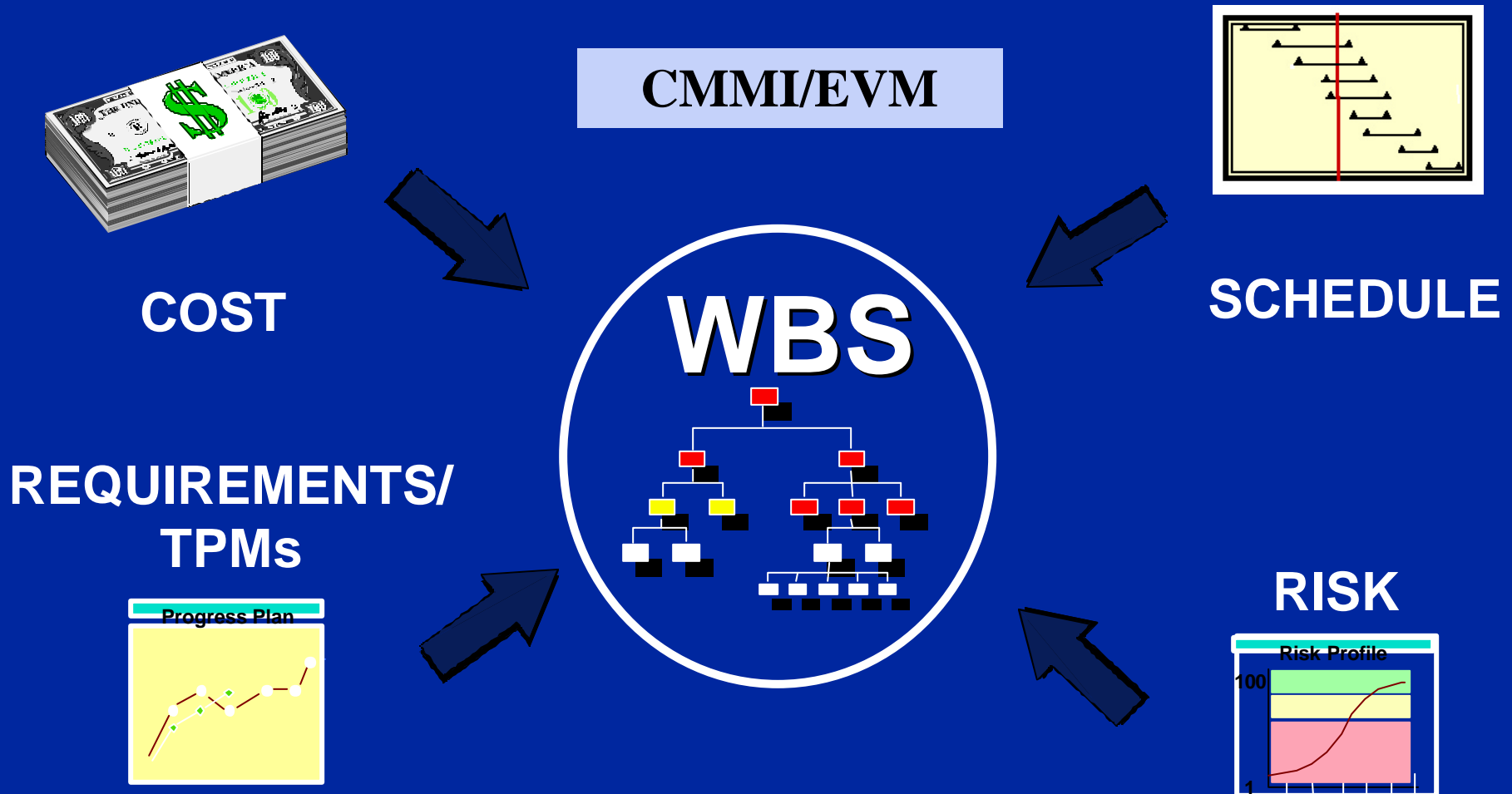**That Integrates the Technical, Schedule, and Cost Parameters of the Contract.**

Best Metrics for Early Warning.

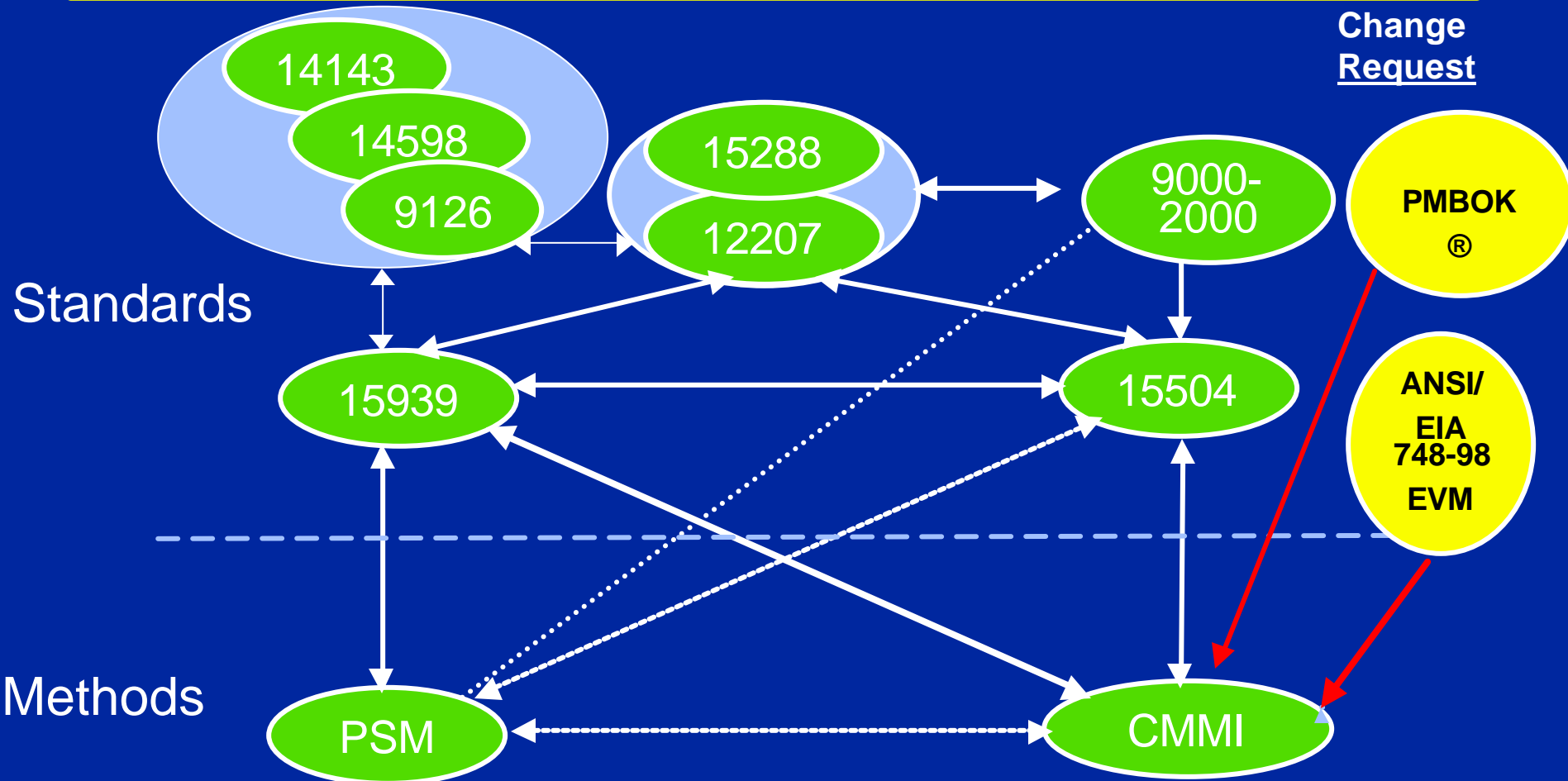# Industry Standard, ANSI/EIA 748-98
"EVM Systems" (Standard)

- **Office of the Under Secretary of Defense (Acquisition and Technology)**
  - **D. Czelusniak, 1997: Only Technique Proven to Effectively INTEGRATE Cost, Schedule and Technical Performance Management**
  - **J. Gansler, 1999:**
    - **Best Management Practice for Complex Projects**
    - **INTEGRATED PROJECT MANAGEMENT Using Earned Value**
    - **Adopt the EVM Industry Standard for Defense**
  - **EVM Also in Project Management Institute Guide to the Project Management Body of Knowledge, 2000 Edition (PMBOK®) . (AKA ANSI/PMI 99-001-2000)**

Integrated Project Planning

CMMI/EVM

COST

SCHEDULE

WBS

REQUIREMENTS/ TPMs

Progress Plan

RISK

Risk Profile

100

1

Add EVM to Framework for Measurement

Standards

14143
14598
9126

15288
12207

9000-2000

Change Request

PMBOK®

15939

15504

ANSI/ EIA 748-98 EVM

Methods

PSM

CMMI

Practical Software Measurement (PSM) ver 3.1
Capability Maturity Model Integration (CMMI), ver 1.02
ISO 9126 -Software Product Quality
ISO 14598 - Evaluation of Software Products
ISO 14143 - Functional Size Measurement

ISO/IEC 15504, Information Technology – Software Process Assessment
ISO/EIC CD 15939, Information Technology – Software Measurement Process
ISO/EIC CD 15288, Information Technology – Life Cycle Management – System Life Cycle Processes
ISO/EIC 12207, Information Technology - Software Life Cycle Processes
ISO 9000:2000, Quality Management Systems

Performance-Based EV

- **Eliminate Waste: Reduce Cost of Using EVM**

- **Select Most Effective Measures of Schedule and Progress**
  - **Identify Key Requirements With Biggest Impact on Cost, Schedule, Functionality, Technical Performance and Risk**
  - **Performance Measurement Baseline (PMB) Tied to Requirements**
    - **Rapid Integration of Project Scope Changes**
  - **Progress of Work Products: Not Tasks, Inchstones**
    - **Of Requirements Development**
    - **Of Technical Solution**
  - **Where Possible, Tie EV to TPM Results**
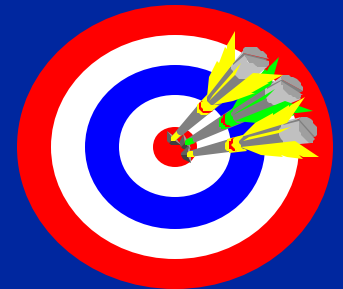
Performance-Based EV

- **Manage <u>Costs</u>, Not Schedule of Support Tasks**
  - **Level of Effort (LOE)**
    - **No Discrete EV for Meetings, Reviews, Recurring Reports**
  - **Allocate Support Budget to Discrete Work Packages It Supports**
- **Reduce Number of Work Packages in EVM System**

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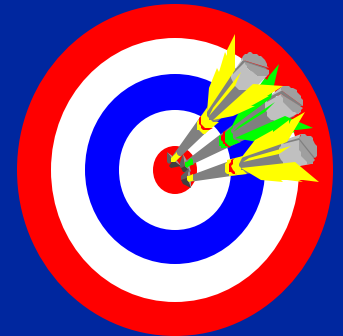
Requirements Development Work Products

Customer Requirements
- Customer Requirements
- Requirements for Verification/Validation
- Test Cases and Expected Results

Product and Product Component Requirements
- Requirements Allocated to Product Functions and Product Components:
  - Derived Requirements
  - Allocated Requirements to Product and Product Components

Interface Requirements

Validated, Functional Architecture

TPMs

Documented, Verified Requirements

Being Customer Focused

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Technical Solution Work Products

Alternative Solutions
  - Alternative Solutions
  - Selection Criteria

Product Component Operational Concepts and Scenarios

Product Component Selection Decisions

Technical Data Package of Product or Product Component

Comprehensive Interface
  - Interface Specifications
  - Interface Control Documents
  - Interface Design and Documents

Implemented Design (Software Code, Fabricated Parts Etc.)

Product Support Documentation
  - Training Materials, User's Manual, Maintenance Manual
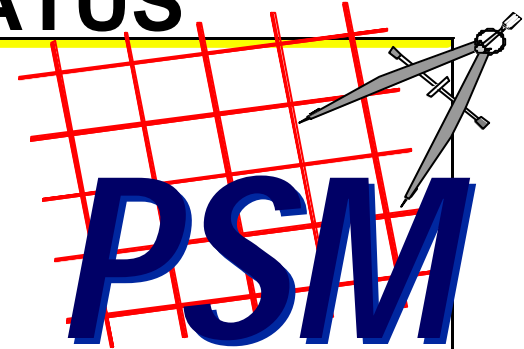
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PSM: REQUIREMENTS STATUS

Issue: SCHEDULE & PROGRESS
Aggregation Structure: FUNCTION
 Category: WORK UNIT PROGRESS

 Typically Collected for Each: REQUIREMENTS SPECIFICATION

DATA ITEM	COMPLETION CRITERIA
Requirements Traced to: ● Detailed Specifications ● Software Components ● Test Specifications ● Tested Successfully	●Completion of specification review ●Baselining of Specifications ●Baselining Requirements Traceability Matrix Successful Completion of all Tests, in Appropriate Test Sequence

Technical Performance Measurement

Interim Reg. DoD 5000.2-R, Para. 5.2
     Performance Metrics to Measure:
          Technical Development and Design,
               Actual vs. Planned
          Meeting System Requirements
     Performance Metrics Traceable to Performance
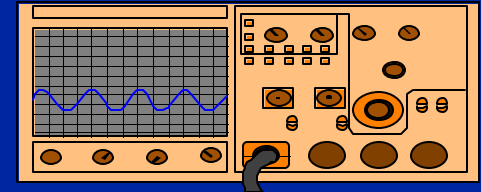   Parameters Identified by Operational User
Systems Engineering Capability Model (EIA/IS-731)
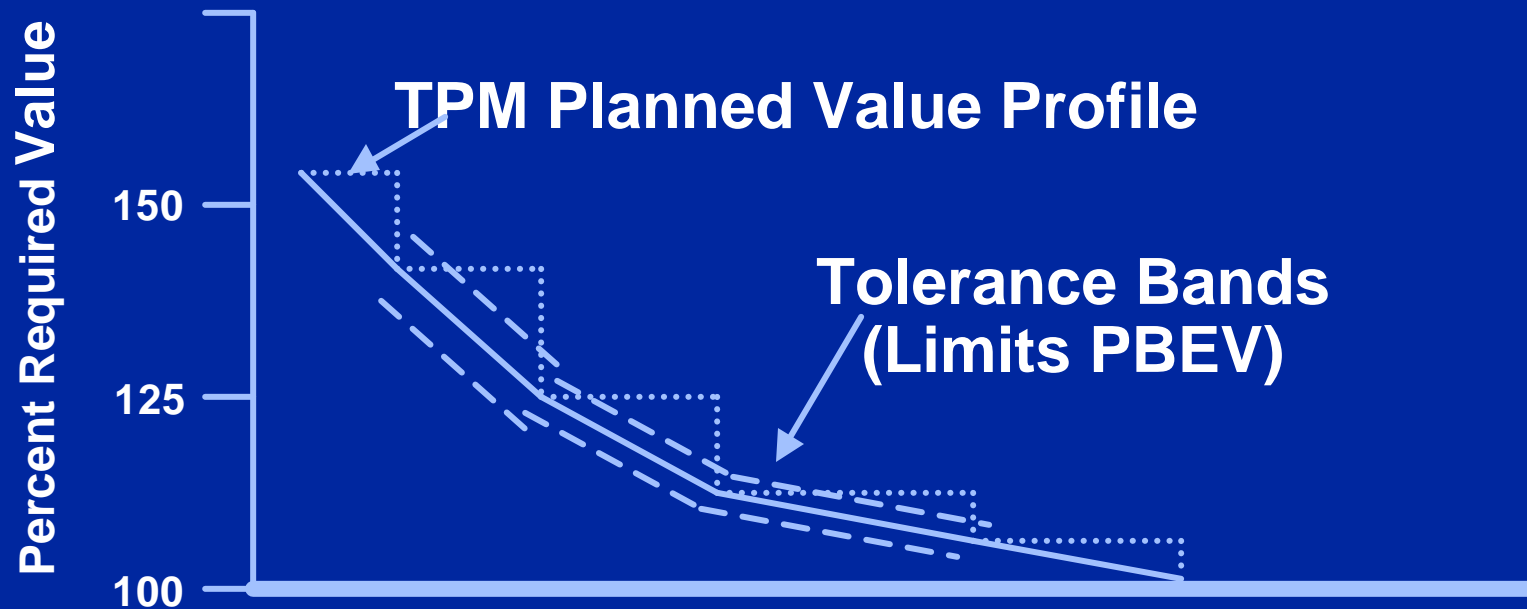   Predict Future Value of Key Technical Parameters
          Of the End System
          Based on Current Assessments of the Systems That
          Make up That End System
Performance-Based Contracting

Technical Performance Plan
with Tolerance Bands

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CMMI PROCESS AREAS and TPM

PROCESS AREA	SPECIFIC PRACTICE (SP)	TPM REFERENCE
REQUIREMENTS DEVELOPMENT	2.1 Establish Product Requirements 3.3 Analyze Requirements	Technical parameters TPMs
TECHNICAL SOLUTION	2.2 Tech. Data 2.3 Design Interface	Functionality, performance Critical parameters
VERIFICATION	3.1 Verify against 3.2 Analyze results	Requirements Compare to TPMs
RISK MANAGEMENT	2.1 Identify Risks	Performance
SUPPLIER AGREEMENT MANAGEMENT	2.2 Execute Agreement	Monitor tech. performance
MEASUREMENT & ANALYSIS	1.1 Measurement Objectives 1.2 Specify Measures	Source: Tech. Needs Base on quality

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CMMI-SE/SW/IPPD Process Areas & *EVM*

Level	Focus	Process Areas	Quality Productivity
5 Optimizing	**Continuous process improvement**	**Organizational Innovation & Deployment** **Causal Analysis and Resolution**	
4 Quantitatively Managed	**Quantitative management**	*Quantitative Project Management* **Organizational Process Performance**	
3 Defined	**Process standardization**	*Requirements Development* *Technical Solution* *Verification* *Validation* *Integrated Project Management* *Risk Management* **Product Integration** **Organizational Process Focus** **Organizational Process Definition** **Organizational Training** **Integrated Teaming** **Decision Analysis and Resolution** **Organizational Environment for Integration**	
2 Managed	**Basic project management**	*Requirements Management* *Project Planning* *Project Monitoring and Control* *Supplier Agreement Management* *Measurement and Analysis* **Process and Product Quality Assurance** **Configuration Management**	**Risk Rework**

CMMI Levels and EVM

LEVEL	PROCESS AREAS
4 Quantitatively Managed	*Quantitative Project Mgt.*
3 Defined	*Requirements Development* *Technical Solution* *Verification* *Validation* *Integrated Project Mgt.* *Risk Mgt.*
2 Managed	*Requirements Management* *Project Planning* *Project Monitoring & Control* *Supplier Agreement Mgt.* *Measurement & Analysis*

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SPs Mapped to EVM Guidelines

PROCESS AREA	SPECIFIC PRACTICE	SUBPRACTICE, CLARIFICATION	EVM GUIDELINE
Project Monitoring & Control	1.1 Monitor project planning parameters	• Progress vs. schedule • Cost • Attributes of work products and tasks	22: Compare EV with time-phased budget and actual cost
	2.2 Analyze issues	Determine actions needed	26: Managerial actions 27: Estimate at Completion 32: Changes to the PMB

SPs Mapped to EVM Guidelines

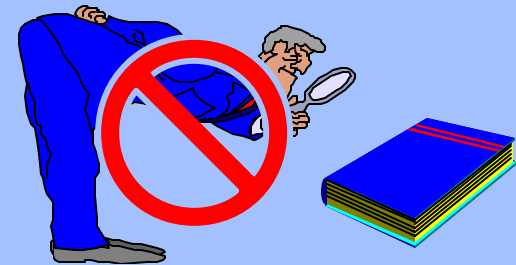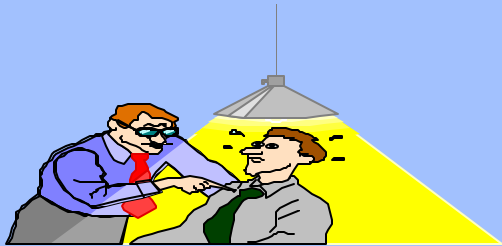| PROCESS AREA	SPECIFIC PRACTICE	SUBPRACTICE, CLARIFICATION	EVM GUIDELINE
Measurement & Analysis	1.2 Specify Measures	•Base Measures: (work product size, cost) •Derived Measures: (EV, SPI) •Specify Operational Definitions	7. Identify physical products, milestones, tech. performance goals..measure progress
Requirements Development	3.3 Analyze Requirements	•Identify key requirements, TPMs .. influence cost, schedule, functionality, risk	7. Same as above

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SPs Mapped to EVM Guidelines

PROCESS AREA	SPECIFIC PRACTICE	SUBPRACTICE, CLARIFICATION	EVM GUIDELINE
Integrated Project Management	1.3 Integrate Plans	• Integrate subordinate plans with project plan • Incorporate into plan definitions of measures and measurement activities	3. Provide for integration of planning, scheduling, budgeting, work authorization, cost processes..and WBS

Note: 24 Specific Practices within 11 Process Areas (Levels 3 and 4) map to 17 EVM Guidelines

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SCAMPI Cost Reduction Opportunity

DCMA One Book

CMMI

- **Compliance With Standard**
- **Assess EVM System Risk**
- **Joint Surveillance Agreement**

Map of SPs to EVM Procedures

– **Minimize On-site Interviews**

And Document Reviews:

Valid Observations

Process Improvement
Company Uses EVM

- **Leverage Investment in EVM to Reduce SCAMPI Costs**
  - **Provide Mapping and DCMA Data to Team**

- **Improve and Standardize EVM Processes**
  - **Implement PBEV**
  - **Upgrade to Achieve Goals**
    - **Process & Product QA**
    - **Organizational Training**
    - **Organizational Process Performance**
    - **Quantitative Project Management**

LEAN

CMMI/ EVM

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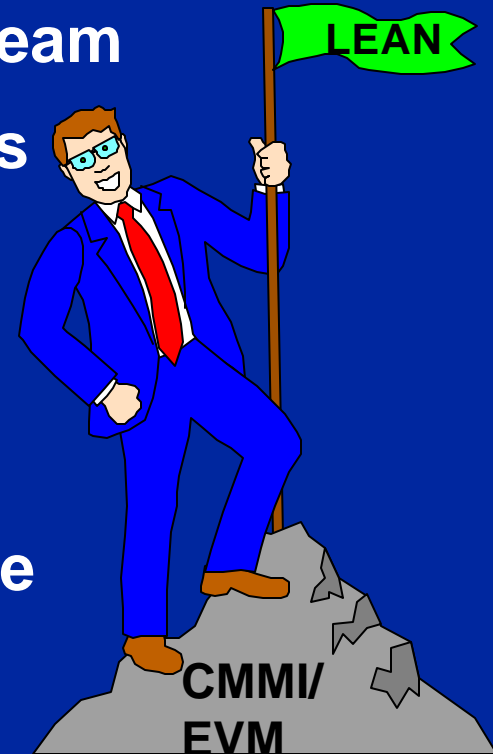
Process Improvement
Company Transition to EVM

- **Identify Strengths and Weaknesses of Current Processes Relative to EVM:**
  - **Standard**
  - **PMBOK® Guide**

- **Commit to Process Improvement**

LEAN

CMMI/EVM

Four Change Requests (CR) to CMMI

- **EV:**
  - References, Definitions From Standard and PMBOK®
  - Clarification of EV Techniques and Terminology:
    - Differentiate Between Estimates and Budget
    - Identify Deviations Using Cost Performance Index (CPI) and Schedule PI
    - Differentiate Between Initial Development and Rework
    - Add TPM
- **To Acquisition Model: Add Monitoring a Supplier's Project Management Process**
- **Add Critical-chain Schedule Management**

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Conclusions

- **EVM - the Only Technique Proven to Effectively INTEGRATE Cost, Schedule and Technical Performance Management**

- **Compliance With the EVM Industry Standard Indicates Achievement of CMMI SPs**
  - **Reduce Costs of Transition and Assessment**

- **Use the Transition to CMMI To:**
  - **Improve EVM Processes or**
  - **Transition to EVM**

- **CMMI Models Should Be Revised to Better Clarify Ties to EVM**